TOWARD A GREATER UNDERSTANDING OF FOOD ACCESS IN MELBOURNE

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INTRODUCTION

This is a scoping paper that addresses healthy food access in Melbourne. The investigation is premised the concept of 'food deserts', spaces within cities that lack 'adequate access' to affordable, healthy food. The paper is more broadly located within the on-going debate around Melbourne's purported two-track urban growth. However, the paper reframes the discussion away from housing supply/demand asymmetries of such planning dysfunction and instead toward potential disparities in healthy food access. This specific exploration aims to investigate a largely un-researched dimension of Melbourne's two-track development and sets out a proposed methodology for mapping 'fresh food' in the MSD (Melbourne Statistical Division) through the use of empirical data and quantitative methods. Future findings intend to provide a more nuanced, evidence-based understanding of whether two-track development is contributing to differences in healthy food access between inner and outer suburbs as well as their relative magnitudes.

Two-Track Development and Healthy Food Access: A Brief Context

Melbourne's two-track urban growth is predicated on excess housing demand that is forcing more middle-income earners toward the fringe in pursuit of home ownership. As such, there are growing concerns over potential polarisation between a wealthy inner-core and a disconnected, under-provisioned outer-ring. Recent development of cheap land in the Growth Corridors has failed to provide affordable housing aligned with the location of the occupants' income generation, cultural consumption and health needs. Much of this failure is attributable to the under-matched provision of public transport, education and general social amenity in relation to housing location. Where infrastructure arguably constitutes the most significant precondition for broad, economic prosperity, current under-provision will unlikely generate enough diverse, stable and well paying jobs to transform these regions into viable urban hubs. As such, outer-suburban growth will not likely provide comparable standards of living to those in the urban core. The adverse implications of urban polarisation extend beyond the obvious economic ramifications of housing market asymmetries. Limited socio-economic mobility and widening income inequality are key associated concerns for Growth Area planning. Healthy food access is one potential aspect of this urban polarisation that has received minimal academic and media discussion, in turn highlighting the need for substantive research.

This research is derived from the 'Food Desert' metaphor. Coined in the 1990s, this concept describes the phenomenon of industrialised urban centres (San Francisco, New York, London) devoid of healthy food outlets. However, the paper redirects this engagement onto the urban fringe in the wake of Australia's large-scale 'periphery' growth. In the advent of Melbourne's ostensible two-track development, this becomes significant considering the unevenness in amenities between the inner core and outer suburbs. Where much of the current literature discusses healthy food access at the urban core that doesn't necessarily suit the local context, a nuanced, Australian-centric focus is needed.
The first question however, is why should one be concerned? In what way is healthy food access an important dimension of urban development? There is increasing consensus within dominant planning discourse (Morland, Wing, Diez Roux, & Poole, 2002; Rose & Richards, 2004) that the physical environment plays a central role in one's health, income capacity and socio-economic mobility. In this way, urban form, transport networks and housing location become key determinants of one's wellbeing. Where affordable, healthy food is a primary component of overall welfare, physical access is paramount. The second question is whether such accessibility is a problem in Melbourne and if so, how severe is it, where is it spatially located and how might it be remedied? Implicit in this examination is a determined threshold of 'adequate access'. This need for a metric lends the study to quantitative methods. In the event that the data yields no significant discrepancies between inner city, suburban and outer suburban areas, the goal becomes understanding what measures ensured this positive outcome and whether they can be translated to other planning related issues.

LITERATURE REVIEW

Over the past 15 years, urban form, transport networks, housing location and neighbourhood demographics have increasingly been considered when studying healthy food access. The incorporation of such factors reflects an expansive engagement with the field, and suggests the built environment plays a critical role in understanding food provision and diet choices. (Morland, et al., 2002; Rose & Richards, 2004) Introduction of the food desert metaphor in the 1990s has come to broadly identify this field of research, though no coherent definition exists. (Apparicio et al., 2007; Cummins & Macintyre, 2002; Gordon, 2011; Rose et al., 2009; Shaw, 2006; Sparks et al., 2009;) Notwithstanding, many key studies interpret this concept as limited supermarket access within areas of socio-economic disadvanatge. (Apparicio, Cloutier, & Shearmur, 2007; Besharov, Bitler, & Haider, 2011; Eckert & Shetty, 2011; Guy & David, 2004; Lee & Lim, 2009; Paez, Gertes Mercado, Farber, Morency, & Roorda, 2010; Schafft, Jensen, & Hinrichs, 2009) The primary objective of the literature is to quantify the location and severity of food deserts and major debates are framed around which factors most significantly affect 'adequate' access to affordable, healthy food. Barriers to access are often conceptualised as spatial, economic and informational. (Eckert & Shetty, 2011; Larsen & Gilliland, 2008; McEntee & Agyeman, 2010) However, the lack of definitional consensus has in part led to a variety of investigation methods that make it difficult to compare the appropriateness of studies. Where the discussion food access is broadly divided between transport access and affordability, (Walker, Keane, & Burke, 2010) key indicators used are urban form, car ownership, residential proximity to supermarkets, income and race.

What is a Food Desert? Theoretical Critique

The 'food desert' metaphor was first officially used in 1996 as part of the UK Government investigation into factors affecting grocery distribution and health outcomes. (Cummins & Macintyre, 2002; Furey, Strugnell, & McIlveen, 2001; Robinson, Caraher, & Lang, 2000; N. Wrigley, Warm, & Margetts, 2003) The specific focus on limited supermarket access within disadvantaged urban areas was part of a broader study into the key determinants of social exclusion in British cities. Outcomes were designed to inform policies to help ensure equitable access to economic and social opportunities. Present day investigation of food deserts include a broad range of indicators in order to better understand how people negotiate space in undertaking the activities necessary for sustaining quality of life. (Paez, et al., 2010; Scott & Horner, 2008)

However, this somewhat adolescent literature that predominately comprises US-based studies, still struggles to adopt a coherent, uniform definition. The concept of a food desert remains an imprecise, open-ended term. It *generally* describes a phenomenon of areas with inadequate retail food provision, without providing any specific parameters to qualify what 'adequate access' may mean. (Shaw, 2006) For example, whilst Bader (2010) assumes food deserts to be a strict matter of spatial accessibility, Guy and David (2004), McEntee and Agyeman (2010) and Morton et al (2005) include food affordability into the overall metric. Hallet and McDermott (2010) and Robinson et al, (2000) include price of travel and the opportunity cost of one's time within their discussion of affordability. Whilst these differences evidence a broad engagement with the topic, it becomes difficult to meaningfully compare scope and results of studies.

The most problematic issue is that much of the research includes socio-economic status within the definition. This interpretation potentially *implies* a correlation between disadvantage and adequate access to healthy food, rather than verifying it through empirical research. Disadvantage itself can be diversely classified, particularly between geographical regions. (Rose et al., 2009) Including a measure of disadvantage in the definition can potentially frame the research so that poorer people are *assumed* to have inferior healthy food access compared to the rest of the population. In their studies of Montreal, both Bertrand et al (2008) and Apparicio et al (2007) find no statistically significant relationship between healthy food supply and the socio-economic status of neighbourhoods. Similarly, Cummins and Macintyre (2002) concede that no clear relationship has been found between household income (as a proxy for disadvantage) and food access in the UK. McEntee (2009) specifically challenges this assumed correlation by asking, 'are these areas really poor…or do they just maintain poor access?' He argues that 'access' – spatial, financial or otherwise – is a more accurate, less misleading concept than food deserts when highlighting food inequalities as it doesn't immediately assume some groups are better off than others. In this way, food deserts are perhaps better understood as a conceptual guide rather than an operational term.

What Factors Affect Healthy Food Access? Arguments, Themes and Assumptions

<u>Changes in Food Provision and Urban Form</u>

Lack of affordable healthy food in cities is located in a discussion around changing urban form over the past 30 years. A majority of studies cite the economic shift toward chain supermarket retailing and their consistent movement away from inner cities to urban peripheries. (Bertrand, Therien, & Cloutier, 2008; Clarke, Eyre, & Guy, 2002; Clifton, 2004; Cummins & Macintyre, 2002; Eckert & Shetty, 2011; Furey, et al., 2001; Guy & David, 2004; Hallett & McDermott, 2010; Larsen & Gilliland, 2009; Lee & Lim, 2009; Morton, Bitto, Oakland,

& Sand, 2005; Robinson, et al., 2000; Smoyer-Tomic, Spence, & Amrhein, 2006) However, Coveney and O'Dwyer (2009), Scott and Horner (2009) and White et al (2004) maintain different spatial findings. Whilst they agree that food provision has moved away from corner stores and independents, they argue that supermarket agglomeration is occurring around shopping centres both within suburbs and the inner city. Despite these particular differences, most studies testify to the importance of urban form in affecting the spatial distribution of supermarket opportunities relative to residential locations. The literature endeavours to untangle the effects of this new spatial composition on 'access' by differentiating between affordability and mobility.

It's important to qualify here that supermarkets are used by nearly every study as a proxy for healthy food. Whilst there are some studies that incorporate other retailers (for example Bodegas), (Gordon et al., 2011) supermarkets are overwhelmingly engaged as the most appropriate representation for healthy food provision. (Apparicio, et al., 2007; Hubley, 2010; Larson, Story, & Nelson, 2009; Morland, et al., 2002; Smoyer-Tomic, et al., 2006) There are however, legitimate criticisms against using supermarkets as useful proxies for healthy food. Many studies have questioned supermarkets as the only relevant measure of healthy food security. (Hubley, 2010; McKinnon, Reedy, Morrissette, Lytle, & Yaroch, 2009; Shaw, 2006) Other food venues including, non-chain supermarkets, grocery stores, ethnic food providers and farmers markets can be better potentially than large-scale supermarkets which can often be the purveyors of some of the worst kinds of packaged and heavily processed foods. The quality of fresh produce can also be of poorer quality at supermarkets than for example, strict fruit and vegetable supplies. (Besharov, et al., 2011)There are also definitional issues regarding what constitutes healthy food. 'Fresh food' is not the only component of healthy food. Notwithstanding, the limitations of this proxy are well advised across studies (Besharov, et al., 2011; Cummins & Macintyre, 2002), and currently no better alternative is provided. The overarching move towards supermarket shopping mirrored by the fall in corner stores and independents (as previously mentioned) arguably make it the best alternative for food mapping.

Food Price Affordability

The first purported outcome of supermarket agglomeration on the urban periphery is a physical decrease of the number of healthy food stores within inner cities. (Eckert & Shetty, 2011; Guy & David, 2004; Larsen & Gilliland, 2009; Morton, et al., 2005; Smith & Morton, 2009) Across the literature, this has shown to have adverse effects for both healthy food availability and affordability. The agglomeration of supermarkets on the fringe has allowed these retailers to capitalize on the economies of scale and positives externalities afforded by cheaper rents and larger plot sizes. The subsequent decrease in production costs translates to cheaper products and better deals for consumers. (Cummins & Macintyre, 2002; Eckert & Shetty, 2011; Robinson, et al., 2000; Smoyer-Tomic, et al., 2006; Neil Wrigley, 2002) The ensuing absence of supermarkets in inner cities creates a lack of local competition, allowing remaining independent grocers to increase their mark-up. (Besharov, et al., 2011; Caraher, Dixon, Lang, & Carr-Hill, 1998; Guy & David, 2004; Morton, et al., 2005; Shaw, 2006; Smith & Morton, 2009; Walker, et al., 2010) This price discrepancy however is not found by Furey et al (2001) in their investigation of food deserts in Northern Ireland, though the authors do attest to the relocation of supermarkets to the urban periphery.

The first assumption is that socio-economically disadvantaged populations are left in the inner city, and cannot afford either the price of healthy food, or the transport costs to travel to supermarkets. Many US studies (Eckert & Shetty, 2011; Gordon, et al., 2011; Larson, et al., 2009; Morland, et al., 2002; Schafft, et al., 2009; Sparks, et al., 2009; Zenk, et al., 2005) indicate this residential pattern of poor communities at the urban core. Sparks et al (2009) however offer a more nuanced position, claiming that the unique urban form of each city will determine whether or not these correlations will hold. As one of only a handful of cross-city comparisons, they evidence that this concentration of poverty in the inner city is true for Detroit, though not for Portland. In the study of Montreal, Canada, Apparicio et al (2007) found no evidence of either supermarket relocation or a poor urban core. However, Larsen and Gilliland's (2008) research on London, Ontario evidenced both the movement of supermarkets away from the inner city and relative socio-economic disadvanatge that remained there. Scott and Horner (2008) extend this critique, foremost agreeing that the supermarkets' urban form has changed, but questioning whether those left without physical access are necessarily the financially disadvantaged. In their study of US cities, Berashov et al (2011) find no significant relationship between income and adequate food access, though this is in stark contrast to the findings of most other American studies mentioned above.

Both debates regarding whether supermarkets are relocating to the urban fringe and if the financially disadvantaged are left behind in the inner city, reinforce that changes in urban form are not universal. Whilst this urban transformation is predominately verified by US research, many Canadian, (Apparicio, et al., 2007; Paez, et al., 2010) Australian (Coveney & O'Dwyer, 2009) and British studies (Cummins & Macintyre, 2002;

Furey, et al., 2001) don't appear to evidence a similar shift, or not to the same extent. This discrepancy between geographical locations reflects the first major divergence in the literature and basis for specific research in Melbourne. This difference speaks to a broader position that the unique urban form, transport system and demographic of each city limits the transferability of accessibility parameters and findings. This discussion also highlights the relative importance of indicators when understanding which factors determine healthy food access. Such differences highlight the usefulness of the paper's specific focus on Melbourne. Where the urban form and spatial demographic configurations distinctively shape local food access, this city-specific research generates uniquely applicable results and recommendations for Melbourne. The conspicuous lack of Australian studies in this field underscores the need for localized research.

Transport Access

With the spatial reconfiguration of food provision toward chain supermarkets, and in some cases relocation to the urban periphery, there is general consensus across both the qualitative (Clifton, 2004; Coveney & O'Dwyer, 2009; Shaw, 2006; Smith & Morton, 2009) and quantitative literature (Bertrand, et al., 2008; Caraher, et al., 1998; Eckert & Shetty, 2011; Forsyth, et al., 2010; Furey, et al., 2001; Hallet & McDermott, 2010; Larsen & Gilliland, 2009; Lee & Lim, 2009; Páez, et al., 2010; Robinson, et al., 2000; Rose, et al., 2009; Scott & Horner, 2008; Smoyer-Tomic, et al., 2006; Sparks, et al., 2009; White, et al., 2004) that transport mobility is the most significant determinant of overall access to healthy food. Implied here is that it's not enough to physically travel between destinations, but also to reasonably transport food.

Barriers to 'adequate' transportation - car, public transit or walking - is echoed throughout the literature and uniformly acknowledged across all geographical locations. What is not agreed upon, are which indicators significantly effect the provision of different transport modes and their relative importance. As such, there are considerable discrepancies between accessibility measures and method techniques, (isochrones, gravity indexes, univariate vs. multivariate regression) accessibility parameters (time vs. distance) and other relevant quantitative measures (density weightings).

In many of the aforementioned studies, car ownership is often used a proxy for socio-economic status. Guy & David (2004) and Walker et al (2010) specifically cite that many low-income households do not have access to a car or cannot afford the costs associated with getting to a supermarket. This reorientation away from previous proxies such as median income is argued to better articulate the hidden disparities in the population. (Bader, Purciel, Yousefzadeh, & Neckerman, 2010; Caraher, et al., 1998; Coveney & O'Dwyer, 2009; Furey, et al., 2001) It also arguably represents the single most significant barrier to healthy food access. (Bader, et al., 2010; Furey, et al., 2001) This appears to be a reasonable relationship where both U.S. and UK census data along with disadvanatge indices (SEIFA) agree that poverty is inversely correlated to car ownership. (Rose, et al., 2009) However, Sparks et al (2009) criticize the immediate usefulness of this proxy, arguing that studies have *assumed* car ownership is an appropriate measure but none have explicitly tested it except for Larsen and Gilliland (2008). Notwithstanding, results from both these studies confirm that where land-use patterns tend toward supermarket agglomeration, private car access is the most important determinant of adequate access to affordable, healthy food. They do not however confirm the relationship between car ownership and socio-economic status. What this argument indicates is that even if one lives in a designated food desert, car ownership implies they are not generally considered of poor access. In evaluating potential food deserts in Adelaide, Australia, Coveney and O'Dwyer (2009) state that, 'it became clear that living in a food desert per se was not in itself a major misfortune. Far more influential was the degree to which car-less households were able to make alternative travel arrangements to assist with food shopping'. What makes this comment so revealing is that the study did not report the occurrence of urban areas devoid of supermarkets, as is the case within much of the American research. (Bertrand, et al., 2008; Eckert & Shetty, 2011; Morton, et al., 2005; Robinson, et al., 2000) This statement seems to reinforce the essentiality of car ownership across a variety of urban forms and supermarket spatial configurations.

One aspect that is unsurprisingly absent from the broad literature is greater research into transport mobility, car access and adequate supermarket provision in gentrified inner cities. This is particularly applicable to Melbourne's current urban form. Whilst this inquiry initially seems outside the purview of food desert research, greater investigation could provide significant insights. Results that confirm a correlation between car ownership and income may empirically reinforce the need to strictly focus on the socio-economically disadvantaged whilst attesting to the usefulness of the proxy. Alternatively, it may disprove the accuracy of such indicators for Melbourne and signify different accessibility issues. Where Melbourne generally reflects a wealthier, well-transport provisioned inner core that gradually diminishes as it expands out, car ownership might not constitute a useful proxy for socio-economic disadvantage as it does in US cities. Again, the uniqueness of urban form, transport and demographic spatiality underscore the need to apply indicators, proxies and accessibility parameters that are suitable to the local setting.

Accessibility Measures: Methodological Critique

The lack of a standard food desert definition has resulted in a variety of research methods in the literature. It has also precipitated a diverse range of unique accessibility criteria. Over the past 5 years, many studies have moved away from the food desert term, and are instead applying a stricter focus on accessibility measures. (Algert, et al., 2006; Eckert & Shetty, 2011; Larsen & Gilliland, 2008; Lee & Lim, 2009; McEntee, 2009; Sparks, et al., 2009) The reorientation toward a more standard accessibility metric endeavours to allow more meaningful comparisons of research design and findings.

Accessibility measures: Isochrone vs. Gravity Index

The most common quantification of food desert location and severity are based on local Geographical Information system (GIS) mapping that produce rich spatial data. This generally involves geo-coding supermarket stores (or other designated healthy food retailers) and then developing an isochrone to determine proximity and quantity of stores to a certain location. Alternatively, some studies develop a store size ranking and then apply a gravity index. In some of these cases, (Bader, et al., 2010; Eckert & Shetty, 2011; Hubley, 2010; Morton, et al., 2005) transport networks are overlaid onto the map. The capacity of gravity indexes to capture both distance and attractiveness of food stores is noted in several studies (Apparicio, et al., 2007; Lee & Lim, 2009; Scott & Horner, 2008; Smoyer-Tomic, et al., 2006). There are however methodological assumptions in both these approaches. Clarke et al (2002) correctly highlights that these measures assume customers only use their nearest sore, which may not be realistic. This discrepancy provides scope for a greater use of mixed methods that is largely absent from the literature, with the exception of Furey et al (2001) and Wrigley et al (2003). As many of these studies assume a correlation between limited healthy food access and socio-economic disadvantage, these metrics and method design reflect the understanding that such populations use their closest food retailer, often to their home. (Caraher, et al., 1998; Clifton, 2004; Donkin, et al, 1999; Walker, et al., 2010; White, et al., 2004) Built into these models are previously discussed ideas that those living in food deserts lack the time, money or private car to shop outside their neighbourhoods at larger. This is one example of how an interpretation of food deserts is reflected in method design.

2. Accessibility parameters

The greatest method limitation is the use of arbitrary distances as a proxy for ‘adequate’ healthy food access. Between the quantitative studies that measure physical accessibility (as mentioned above), distance thresholds for walking to a supermarket range from 400m (Church, et al, 2000) to 1km (Apparicio, et al., 2007; Larsen & Gilliland, 2008; Smoyer-Tomic, et al., 2006; Sparks, et al., 2009) All other studies hover around 500m, with the exception of Algert et al (2006) at 800m. The range of distances used for acceptable car travel in urban areas is equally diverse from 1.6km (Hubley, 2010) to 3km (Bertrand, et al., 2008) to 5km. (Bader, et al., 2010) (APPENDIX A)

Páez et al (2010) severely criticizes such studies that rely on indicators of accessibility calculated by using fixed cut-off values that have not been empirically validated. The authors argue that as greater statistical evidence suggests travel behaviour is neither constant across space, nor across individuals with different socioeconomic profiles (Larsen & Gilliland, 2008; Páez, et al., 2009, Sparks, et al., 2009) a more extensive set of explanatory variables (age, income, household structure, single parent families, mobility tools, occupation, urban form) is needed to establish meaningful distance thresholds. Rose et al (2009) extend this position, arguing that ‘adequate’ distances should be unique to each city and their specific urban form. Again the difference between geographical regions is mentioned. Studies in the UK considered 500m as a reasonable walking distance whilst research in Canada has used 1km (Larsen and Gilliland, 2008). Where American cities tend to be even more spread out, higher thresholds may be warranted.

Where This Research Sits

The most significant implication of this research is a greater understanding of the individual factors that affect healthy food access. However, definitional issues need to be addressed. Where more studies - particularly outside the US - are not evidencing the spatial configurations of ‘typical’ food deserts, current definitions will likely fail to identify food access problems. This is one practical, adverse effect of incorporating socio-economic disadvantage into the wider analysis. What this suggests is that there are potentially food access problems that lie outside the particular scope of food deserts as generally defined by current research. Where urban form, transport networks and population demographic play critical roles understanding food provision and diet choices, greater nuance is needed in method design and indicators used. This type of research also particularly lends itself to further multivariate regression analysis that is being increasingly integrated into newer studies. (Apparicio, et al., 2007; Lee & Lim, 2009; Morland, et al., 2002; Morton, et al.,

2005). The paper endeavours to breach many of these limitations through empirically validated, Melbourne-oriented research, providing localized findings in this developing field.

METHOD

Research Questions and Overview

The research is framed around four key questions:

1. *Are there transport captive food deserts (TCFD) in the Melbourne Metropolitan Region?*
2. *Where are they?*
3. *How severe are they?*
4. *What characteristics might determine the severity of a TCFD?*

The questions are consciously designed to avoid previous definitional ambiguities. They are purposefully not restricted to investigating food accessibility in areas of socio-economic disadvantage, removing the implied positive correlation (or perhaps causation) between higher socio-economic status and better access to healthy food. The study is directly framed around strict measures of spatial access as understood through the paradigm of transport – walking, public transit or private automobile. The intuition is to foremost identify areas where people cannot physically access supermarkets. This is captured in the first, overarching question. From here, the research spatially locates such areas, determines their relative severity and finally investigates factors that may contribute to, characterise or produce physical inaccessibility.

The method of investigation represents a three-stage, quantitative approach. The order of the research questions reflects the logical progression of the analysis, and is echoed through each successive, methodological step. This approach is designed to create a diagnostic framework through the gradual layering of data. The intention is to develop complex, spatial examination of food accessibility in Melbourne through a logical, quantitative process, where each step adds a layer of analytical complexity.

It is important to note that the method does not assume the data will evidence food deserts in Melbourne. Rather, the research endeavours to spatially locate areas of relative inaccessibility to healthy food. In this way, the food desert metaphor is engaged as a conceptual guide rather than an operational term. A potential finding that illustrates no significant spatial inaccessibility across the MSD (Melbourne Statistical Division) provides the groundwork for others studies to look at different barriers. Through this arguably more intuitive process, the objective is to take the first step in investigating impediments to healthy food access that begins with exploring basic, spatial accessibility. Food and transport affordability are not considered in this study and constitute areas for further research.

Method Tools, Parameters and Data Sources

Tools

The method employs geo-spatial mapping using ArchGIS to determine the location and severity of food access in Melbourne. It then performs a series of statistical regressions to determine the significance and magnitude of indicators used.

Parameters

The analysis is exclusively focused on metropolitan Melbourne. The unit of analysis operates at the census tract level, which is then aggregated to form the Melbourne Statistical Division (MSD). Whilst this singular focus on Melbourne denies the usefulness of cross-city comparisons, the scope of the paper precludes further examples. Such comparisons form the basis for further research.

Data sources

Development of spatial data includes the production of a geo-coded supermarket database. Each location has been sourced from the specific supermarket website that lists store locations. These are:

http://www.coles.com.au/Stores-Services/Locations-trading-hours.aspx
http://www.woolworths.com.au:80/wps/wcm/connect/website/tools/store+locator
http://www.aldi.com.au/au/html/service/store_locations.htm
http://iga.dynamiccatalogue.com.au/portal/storelocator
http://www.foodworks.com.au/contact-us.

Public transport networks are then overlaid onto the supermarket map through GIS shape files legally obtained through a specific agreement with MetLink. These maps indicate bus, tram and train, routes and stops. Car ownership rates per census tract have been obtained via the Census CData program, freely available from the Australia Bureau of Statistics (ABS) website http://www.abs.gov.au/cdataonline.

Method Section A: Macro Analysis

Part 1: Spatially Locating Potential Deserts and their Relative Severity

Spatial investigation of relative food access is undertaken through the creation of a gravity index. This method is used in contrast to other common accessibility measures such as isochrones. The benefit of a gravity index is that it enables the analysis to engage both the relative distance and attractiveness of different, proximate supermarkets. The intuition and benefit of this kind of metric is that it doesn't assume that all stores are homogenous, providing the same choices, availability and food prices. Instead, it allows greater scope to differentiate between preferences, providing a more nuanced analysis of one's utility function.

'Attractiveness' here is defined in terms of size of the supermarket, where larger chains are assumed to maintain better availability of healthy foods compared to others. As such, the gravity index foremost requires the development of a supermarket ranking. This is expressed in a tier system where larger, more established chains rank highest. This creation of a potentially arbitrary ranking is system is used by (Apparicio, et al., 2007; Hubley, 2010; Larson, et al., 2009; Morland, et al., 2002). It operates according to the logic that larger stores, by virtue of their operational size, are able to more efficiently capitalize on economies of scale and provide consumer with better deals.

Table 1: Supermarket Rankings

Ranking (From highest to lowest level of attractiveness)	**Supermarket Chain**
Tier 1	Coles, Woolworths (Safeway)
Tier 2	Aldi
Tier 3	IGA/Ritchies
Tier 4	FoodWorks

What the ranking does not capture is the relative differences between tiers - that is the magnitude between tiers appears to be the same, though this isn't necessarily true. This qualification aside, the ranking creates a legible format to incorporate a measure of relative 'attractiveness' into spatial accessibility.

The supermarket data generally appears to reflect a constant spacing of stores across the MSD. What this seems to indicate is that supermarket land use patterns in Melbourne don't appear to reflect the US context where chain stores have relocated to the urban periphery. As such, there is no immediate assumption that households in the inner city are worse off. By extension, it also doesn't presume that these populations lack the time, money or private car to access 'better' supermarkets. More broadly, where the analysis isn't spatially directed to areas of relative socio-economic disadvantage, there is no initial assumption that people in one particular area are any better off than others. What this reinforces is the need for location specific research into healthy food access.

The primary operational component of the gravity index is determination of distance parameters. This metric is designed to reflect levels of relative accessibility, where measurements are taken from census tract centroids. One commodity that most people have limited amounts of is time. If a supermarket takes more than 20 minutes to access by whatever mode, then it is unlikely to be reachable to most. Thus in determining a method of measuring 'acceptable travel', time is expressed in distance, such that a 5minute walk is captured according to a physical area. (Hubley, 2010) Distances are calculated through networks such as distance across roads - computed from an average walking speed - and on public transport. (Hubley, 2010; McKinnon, et al., 2009) This is opposed to Euclidian methods that measure 'as the crow flies'. It is acknowledged that this method is still susceptible to other physical and behavioural barriers such as weather and public transit delays, physical disabilities and security concerns, which would all decrease the distance travelled in the same time. In this way, distance thresholds represent the upper-limit of what could be considered 'adequate access'. Using conservative estimates from Bertrand et al (2008), Clarke et al (2002), Furey et al (2001), Hallet & McDermott (2010), Larsen and Gilliland (2008) and Wigley et al (2003), the upper distance for walking and public transit limit is set at 500m, which is broadly correlated to 20min. Intervals are set at 100meters. Public transit is set at the same distance threshold to walking as it often involves navigating to and from the station. Distance thresholds for cars have a conservative upper limit of 3km as used by Bertrand et al (2008) and are staged at intervals of 500meters.

Public transport networks are then interfaced with the GIS supermarket location map, according to specific distance specifications. This produces a map that indicates a graded measure of healthy food access in

Melbourne according to public transport provision. This can also be understood as representing those who are public transport captive. This first step is colloquially defined as locating 'desert-i-ness', or determining areas of relative spatial disadvantage to supermarkets.

Part 2: Car Captivity - Is the 'desert-i-ness' a problem?

Part 2 asks whether public transport captivity is actually a problem. Car ownership rates per census tract are overlaid on to the previous map of public transit food accessibility. The intuition is that a singular measure of public transport captivity may not necessarily provide a meaningful representation of overall inaccessibility if one owns a car. That is, it might not matter if one doesn't have 'adequate' access to public transport (however determined) if they have car access. What this doesn't capture are those that do not own a car but via some arrangement (relatives, friends, other organisation) maintain access to a private vehicle for food shopping. The second caveat is that car ownership arguably implies the ability to use that vehicle, which in some cases may not be true. Notwithstanding, mapping car ownership rates per census tract provides a more accurate representation of where overall transport captive food deserts appear to be in the MSD.

In contrast to other studies, this particular method doesn't assume a correlation between socio-economic status and car ownership rates. Due to Melbourne's current urban form that reflects a wealthier, better public transit provisioned inner core that gradually decreases towards the urban growth boundary, those living progressively further out may own a car despite their relative income.

Method Section B: Micro Analysis

Part 3: Possible Characteristics - How relevant are the indicators?

Part 3 employs statistical regression to determine which indicators may contribute to, or produce areas of relative spatial inaccessibility, highlighting their comparative significance and magnitude. Conceptually, this final analysis endeavours to identify whether healthy food access in Melbourne is significantly correlated to factors commonly indicative of socio-economic status. Indicators are divided into four categories:

Urban Form

- Distance from the CBD
  As Melbourne becomes less densely populated and physically more spread out toward the fringe, is distance from the CBD positively correlated to greater inaccessibility to healthy food?

- Characteristics of transport system: Distance from a train/tram/bus spot
  Is greater proximity to public transport positively correlated to better access to supermarkets?

Income

- Median income
  Is income correlated to healthy food access?

- SEIFA index – level of Socio-economic disadvantage
  Is (the level of) healthy food access correlated to relative socio-economic disadvanatge?

Population Demographics

- Age of the population
  Is access contingent on one's age? For example, where are the elderly living and are they more susceptible to access issues?

Other

- Mortgage/Rent stress (proportion of income)
  Median income may not be as relevant when discussing access issues, demographic configurations or disadvantage (if relevant). The relatively high rent/mortgage stress in Melbourne makes this is a local indicator that may provide a more sophisticated analysis of what affects access to healthy food

CONCLUSION

This is the first of a two-part research project into healthy food access in Melbourne. As a scoping paper, it foremost sets out a strong theoretical basis for nuanced research into food accessibility in Melbourne. Emerging from the Food Desert metaphor, it highlights the centrality of healthy food access to overall wellbeing and connects it to urban form, residential location and transport networks. Where this field is largely absent in the Australian content and where previous research findings are shown to be highly

contingent on the specific urban form and demographic configurations of each city, the paper advocates for highly stylised, place-specific research according to quantitative methods. It then proceeds to set out a proposed method for mapping healthy food access in Melbourne. Findings to this study are expected in early February 2012.

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APPENDIX A
TIME/DISTANCE ACCESSIBILITY THRESHOLDS IN FOOD DESERT MODELS

TRAVEL MODE	AUTHOR/S	DISTANCE	TIME
Walking			
	Algert et al.	O.8km	15min
	Apparicio et al (2007)	1km	
	Bertrand et al (2008)	0.5m	
	Church et al (2004)	0.4km	
	Clarke et al (2002)	0.5km	
	Furey et al (2001)	0.5km	
	Hallet & McDermott (2010)	0.5km	
	Larsen and Gilliland (2008)	0.5-1km	15min
	Social Exclusion Unit (2003)	0.5km	
	Smoyer et al (2006)	0.5-0.8-1km	
	Sparks et al (2009)	1km	
	Wigley et al (2003)	0.5km	
Public Transit			
	Social Exclusion Unit (2003)		45min
Car			
	Bader (2010)	5km	
	Bertrand et al (2008)	3km	15 min